Pitfalls during the Embolization and Evaluation after the Embolization for the Skull Base Meningiomas

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Summary

Pitfall during the embolization and evaluation after the embolization for skull base meningiomas supplied by meningeal arteries of internal carotid artery (ICA) are reported. This study includes 15 cases of skull base meningiomas (two males and 13 females) that supplied by meningeal branches of internal carotid artery. The preoperative embolization was performed by these feeders. MRI findings and serum levels of C-reactive protein (CRP) after the embolization were examined. In ten patients among 15 patients the meningeal branches of ICA were dominant feeders. In ten patients out of 15 patients, the embolization from the meningeal branches of ICA was possible. Eight patients out of these ten patients were suffered from high fever and increase of serum level of CRP after the embolization. During the embolization for skull base meningiomas, the existence of collateral pathways between the ICA system and external carotid artery system were identified. The increase of serum levels of CRP might be recognized in the patients that effective embolization were performed.

Introduction

Hypervascular skull base tumors can pose considerable problems to surgical removal, because their vascular supply is usually difficult to occlude before resection of the bulk of the tumor. Depending on the tumor size, location, pattern of blood supply, and the anticipated difficulties of surgical extirpation, preoperative superselective embolization may be required. Continued improvement in angiographic equipment, embolic agents, microcatheter and microguidewire technology, and operator experience have enabled smaller intracranial and extracranial vessels to be embolized in the treatment of a variety of vascular diseases, including pial-supplied meningiomas, hemangioblastomas, dural arteriovenous malformations (AVMs), brain AVMs, and facial AVMs. Preoperative embolization for highly vascularized tumors is an indispensable technique for facilitating their surgical removal by decreasing blood loss during the surgical removal [1]. We report the efficacy and pitfalls of preoperative embolization for the skull base meningiomas.

Material and Methods

From February 2001 to April 2004, preoperative embolization was attempted for 15 cases of skull base meningiomas supplied by meningeal branches of the internal carotid artery (ICA). As for 15 treated cases, patients' ages ranged 42-70 (mean 55.3) years and two males and 13 females. Tumor removal operation was performed within 46 days (mean 11.7 days).

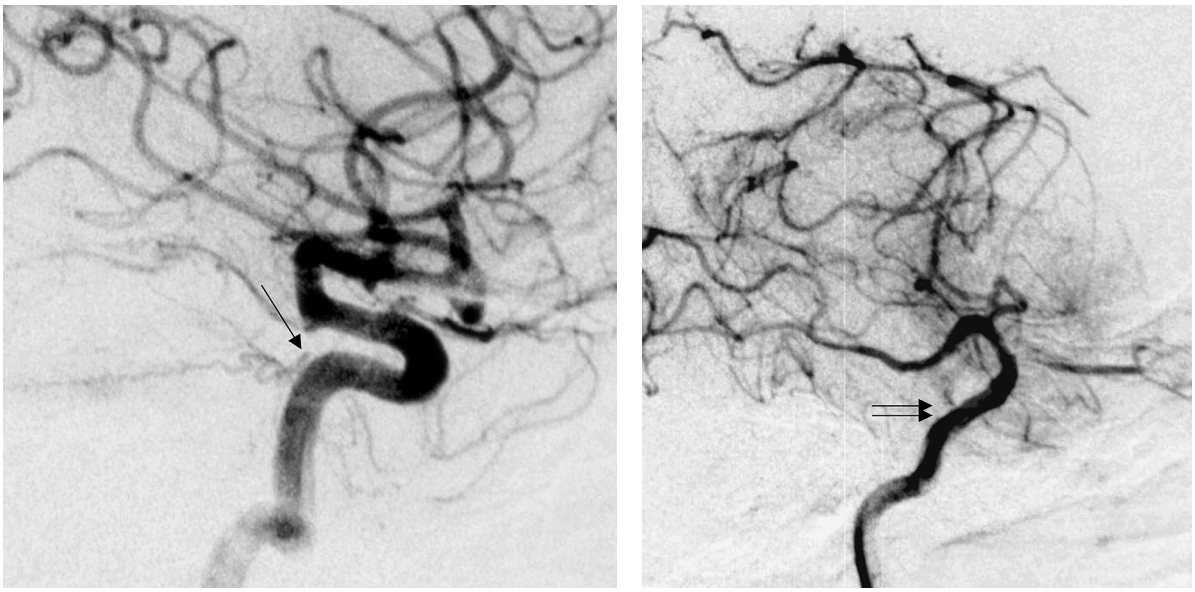

Figure 1 Embolization of the meningeal branch of the ICA was not achieved because of the narrow meningeal branch (right: double arrows), and the acute angle of its origin (left: arrow) in some cases.

Preoperative embolization with endovascular surgery was performed from a transfemoral approach under local anesthesia with DSA. The microcatheter (Fastracker-18MX: Target Therapeutics, Fremont, Calif., U.S.A.) was passed through the guiding catheter and its tip was inserted into the tumor-feeding arteries. PVA particle were injected into the feeding vessels.

We examined the correlation between the dominant feeder embolization and serum level of C-reactive protein (CRP) after the embolization and discussed the pit falls of the embolization of the meningeal branch of the ICA.

Results

The location of meningiomas was petroclival in six cases, sphenoidal ridge in three cases, cavernous in two cases, posterior clinoid in two cases and others in two cases (petrotentorial, tuberculum sella). All 15 meningiomas were supplied by meningeal branches of ICA. The distribution of feeding artery was meningeal branches of ICA dominant in nine cases and the external artery dominant in six cases. We could perform the dominant feeder embolization in 12 cases and the embolization from the meningeal branch of ICA in ten cases without major complications after embolization. Embolization of the meningeal branch of the ICA was not achieved because of the narrow meningeal branch in three cases, and the acute angle of its origin in two cases (figure 1).

Eight cases out of ten cases, that

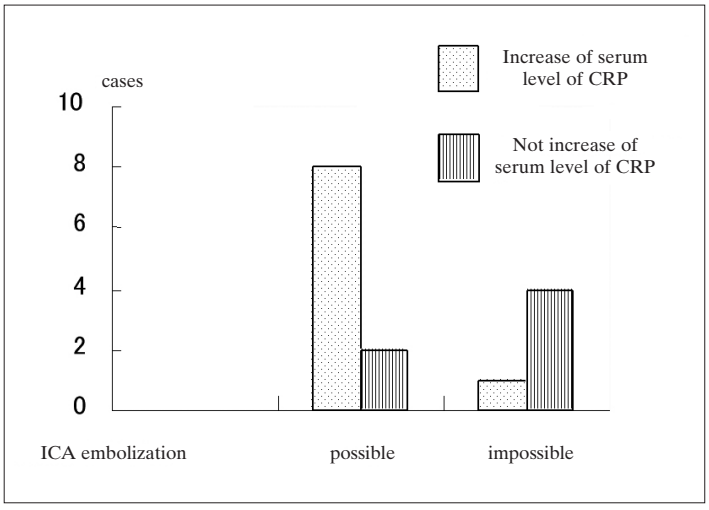

Figure 2 Eight cases out of ten cases, that the embolization of the meningeal branches of ICA was achieved, showed a fever up and increase of serum levels of CRP after the embolization. On the other hand, only one case of five cases that the embolization of the meningeal branch of the ICA was not achieved showed increase of serum levels of CRP after the embolization.

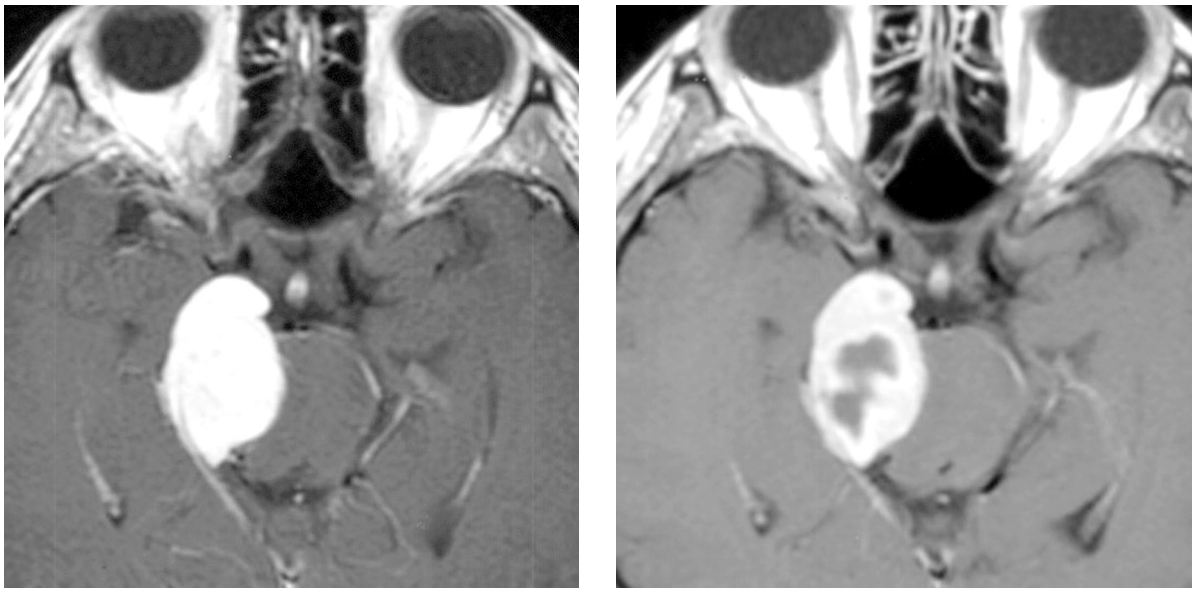

Figure 3 On MRI (left:pre-embolization, right: post-embolization) after embolization intratumoral necrotic change was identified.

the embolization of the meningeal branches of ICA was achieved, showed a fever up and increase of serum levels of CRP after the embolization. On the other hand, only one case of five cases that the embolization of the meningeal branch of the ICA was not achieved showed increase of serum levels of CRP after the embolization (figure 2).

On MRI after embolization intratumoral necrotic change (figure 3) was identified in eight cases and volume reduction in one case. In eight cases with post-MRI changes, five cases showed the increase of serum levels of CRP. On the other hands, four cases out of seven cases without post-MRI change showed the increase of serum levels of CRP after the embolization (figure 4). During or before embolization, the collateral pathway between the ICA system and external carotid artery (ECA) system was identified in three cases (figure 5D, 6).

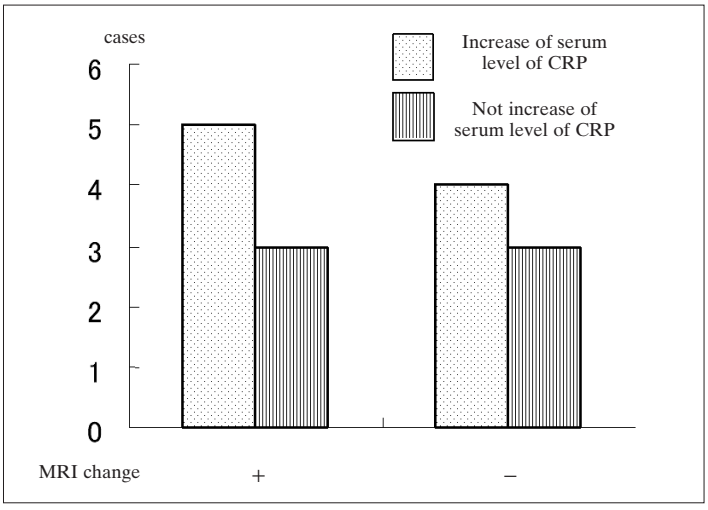

Figure 4 In eight cases with post-MRI changes, five cases showed the increase of serum levels of CRP. On the other hands, four cases out of seven cases without post-MRI change showed the increase of serum levels of CRP after the embolization.

Representative Case

Case 1

A 62-year-old woman presented with gait disturbance and vertigo. MRI demonstrated a well enhanced tumor arising from right petroclival region (figure 5A). Right external carotid angiography demonstrated that feeding arteries were ascending pharyngeal artery and middle meningeal artery. Right internal carotid angiography demonstrated that feeding arteries were meningohypophyseal trunk and inferior lateral trunk (figure 5C). Superselective cather-

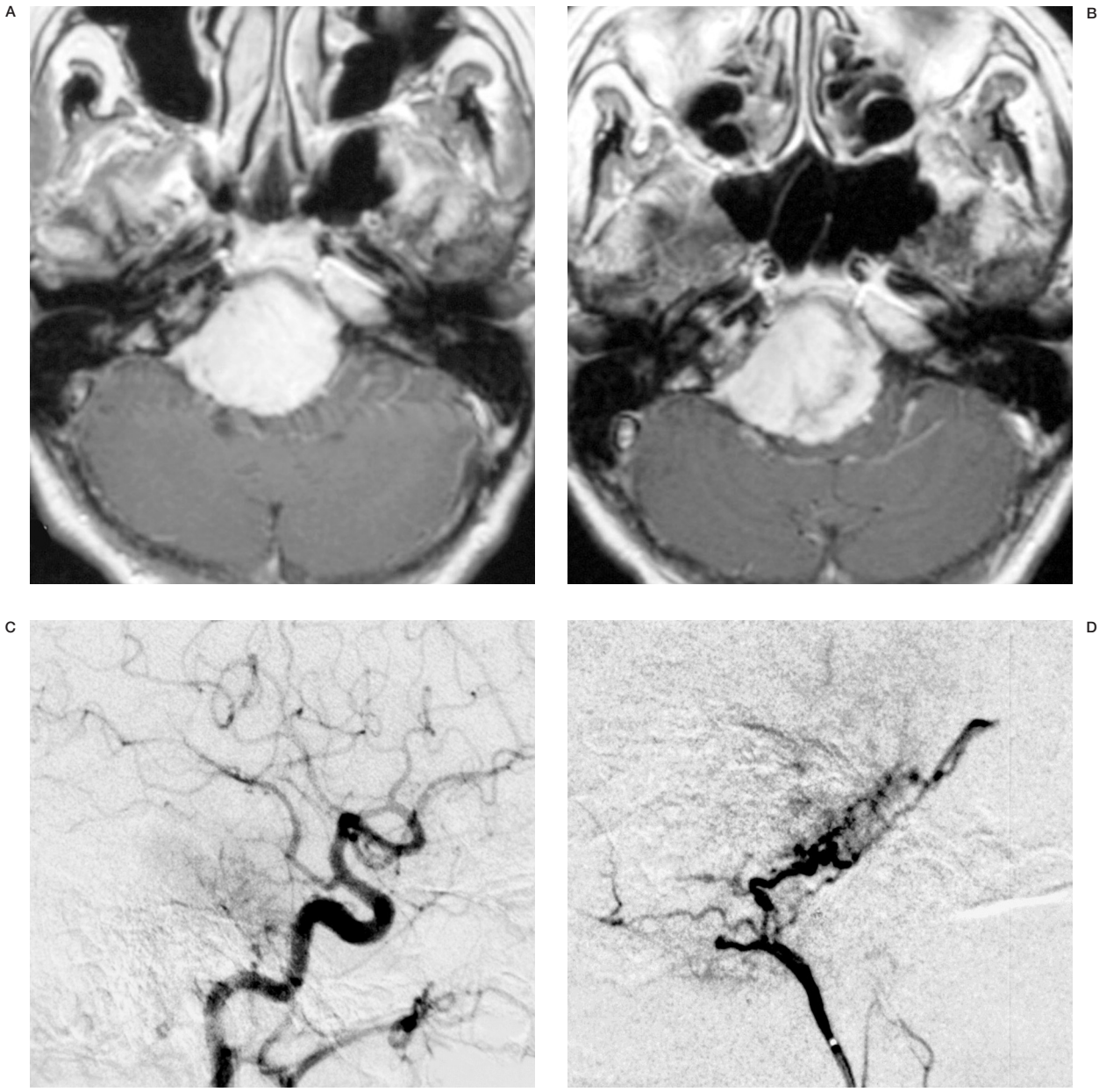

Figure 5 A) MRI demonstrated a well enhanced tumor arising from right petroclival region. B) Ten days after, MRI demonstrated the poor enhanced area in the tumor, which was thought a necrotic change. C) Internal carotid angiogram (left) before the embolization showed the tumor stain supplied by meningohypophyseal trunk (MHT) and inferior lateral trunk. D) Ascending pharyngeal arteriogram (right) after the embolization from the MHT showed the subtotal devascularization of the tumor stain and collateral pathway between the clival branch of the ascending pharyngeal artery and MHT.

ization to the inferior lateral trunk and meningohypophyseal trunk were impossible because of their small caliber and acute angle of their origins. After superselective catheterization of the middle meningeal artery and ascending pharyngeal artery, PVA particles (50-150 micron) were injected. During injection from the ascending pharyngeal artery, The ICA appeared via collateral pathway (figure 5D). The injection of PVA particles stopped. The serum level of CRP did not increase. Ten days after, MRI demonstrated the poor enhanced area in the tumor, which was thought a necrotic change (figure 5B).

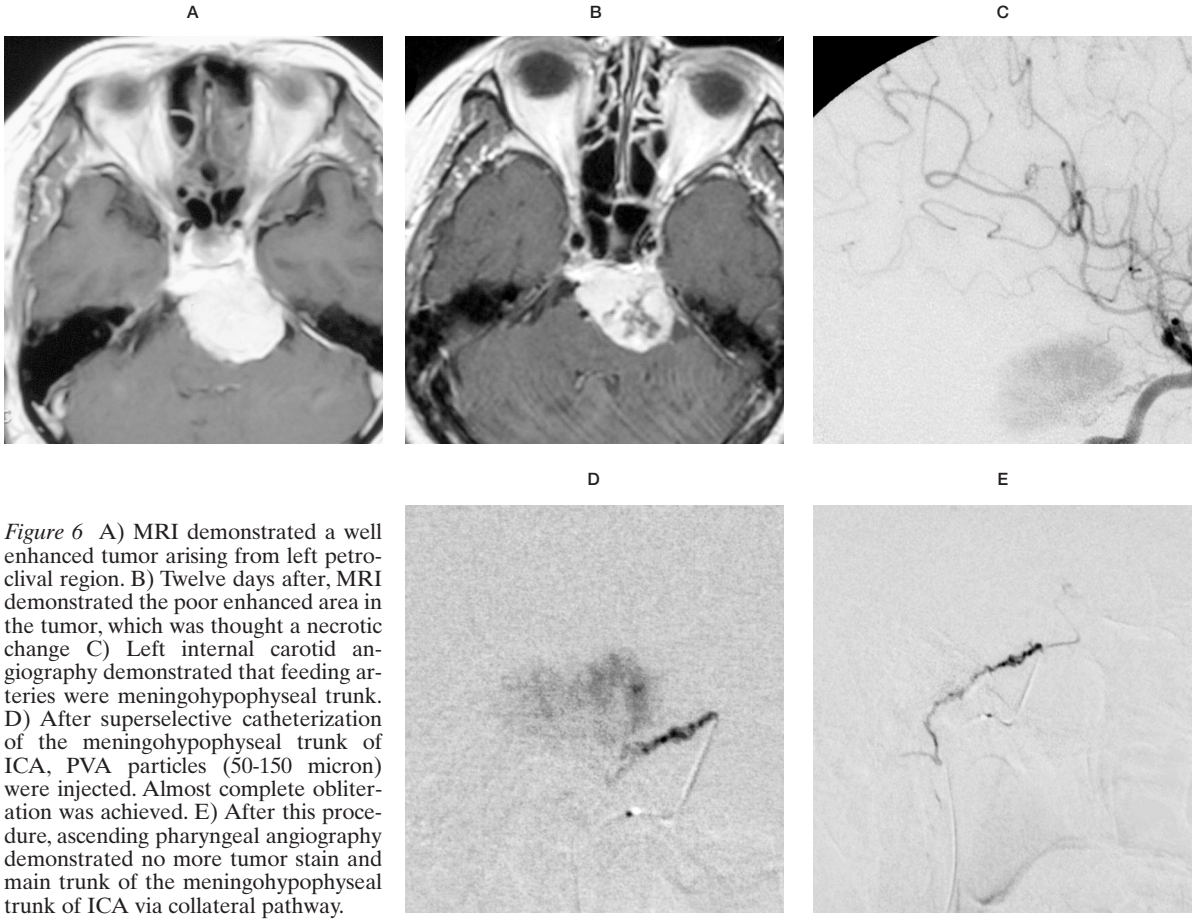

Figure 6 A) MRI demonstrated a well enhanced tumor arising from left petroclival region. B) Twelve days after, MRI demonstrated the poor enhanced area in the tumor, which was thought a necrotic change C) Left internal carotid angiography demonstrated that feeding arteries were meningohypophyseal trunk. D) After superselective catheterization of the meningohypophyseal trunk of ICA, PVA particles (50-150 micron) were injected. Almost complete obliteration was achieved. E) After this procedure, ascending pharyngeal angiography demonstrated no more tumor stain and main trunk of the meningohypophyseal trunk of ICA via collateral pathway.

Case 2

A 61-year-old woman presented with left facial spasm. MRI demonstrated a well enhanced tumor arising from left petroclival region (figure 6A).

Left external carotid angiography demonstrated that feeding arteries were ascending pharyngeal artery. Left internal carotid angiography demonstrated that feeding arteries were meningohypophyseal trunk (figure 6C). After superselective catheterization of the meningohypophyseal trunk of ICA (figure 6D), PVA particles (50-150 micron) were injected. Almost complete obliteration was achieved. After this procedure, ascending pharyngeal angiography demonstrated no more tumor stain and main trunk of the meningohypophyseal trunk of ICA via collateral pathway (figure 6E). At the post-embolization period, the serum level of CRP increased to 20.9. 12 days after, MRI demonstrated the poor enhanced area in the tumor, which was thought a necrotic change (figure 6B).

Discussion

Continued improvement in angiographic equipment, embolic agents, microcatheter and microguidewire technology, and operator experience have enabled smaller intracranial and extracranial vessels to be embolized in the treatment of a variety of vascular diseases.

Skull base meningiomas are supplied by meningeal branch of ICA and ECA. Because the origins of the meningeal branches of ICA are small and often arise at an acute angle, direct catheterization and seating can be difficult, posing considerable risk of reflux into the cerebral circulation. In addition, these sharp turns may be particularly vulnerable to perforation. When these problems are kept in mind, the embolization to these branches is often possible and safely. Skull base meningiomas are often supplied by these meningeal branches of ICA. Therefore, at the operation via subtemporal approach, transpetrosal-transtentorial approach and so on, the main feeder is located at the bot-

tom of the tumor in the operative field. So the preoperative embolization for these skull base meningiomas is especially useful for resection of the bulk of the tumors.

As meningeal branches of the ICA supply the cranial nerves and have collateral pathway with the external carotid system, the embolization with smaller particles might be dangerous. However, if the goal of embolization is to decrease intraoperative bleeding, the embolic material must pass deep into the vasculature of the tumor. More proximal vascular occlusion is adequate; the surgeon can do that. Superselective catheterization of vessels supplying the tumor must be performed. Wakhallo [2] conclude in his study that preoperative extended microembolization of intracranial meningiomas with 50- to 150-µm PVA particles induces a higher degree of effective tumor devascularization and necrosis than can be obtained with larger particles and no additional risks are associated with this technique. Latchew [3] described that meningioma embolization probably is efficacious, only if the procedure is done with exquisite technique using super-selective catheterization and tiny particles injected in diluted solutions over a long period of time.

Cytokine interleukin (IL)-6 is commonly used as a mediator of the inflammatory response and an early marker of tissue damage [4]. It plays a role in the induction of an acute-phase response, and it has anti inflammatory activity [4,5]. The concentrations of IL-6 in blood increase after surgery in correlation with the degree of surgical stress. CRP, which IL-6 is capable of inducing, is also measured as an indicator of surgical stress. In this study, the effective embolization from the meningeal branches of ICA, as the post-MRI showed the necrotic change, could induce the increase of serum levels of CRP. The serum levels of CRP might indicate the efficacy of embolization

Conclusions

Preoperative embolization for the skull base meningiomas supplied by meningeal branches of ICA is often possible by superselective catherization. It is important during the embolization that the collateral circulation between the ICA and ECA system and supply to the cranial nerves are kept in mind. The serum levels of CRP might indicate the efficacy of the embolization.

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